236. AUTOMATIC TEMPERATURE & HUMIDITY REGULATION.
44

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July 16, 1935. G B. DUFFIELD 2,008,323

CONTROL DEVICE

Filed June 22, 1933

Fig 1.

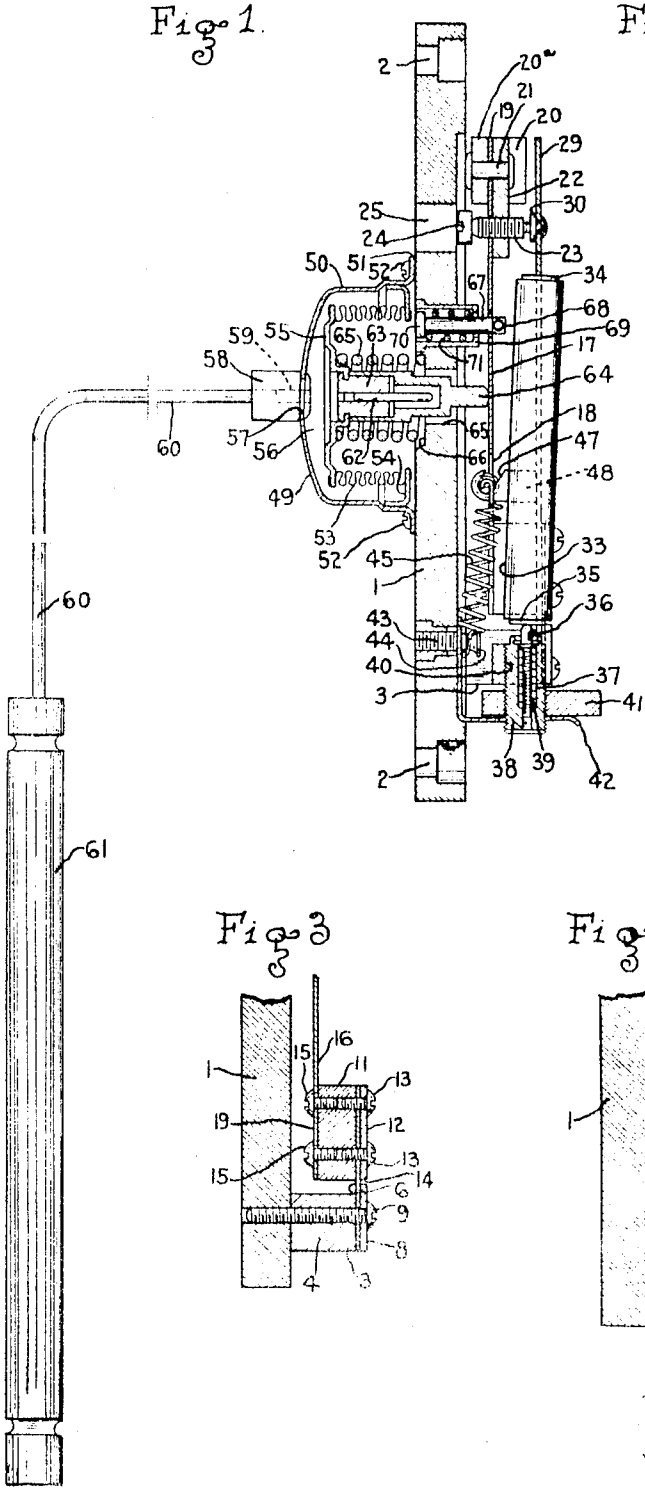


Fig 2

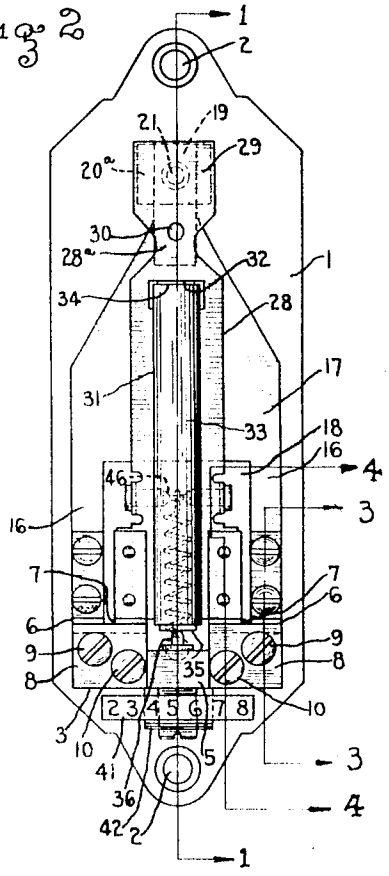
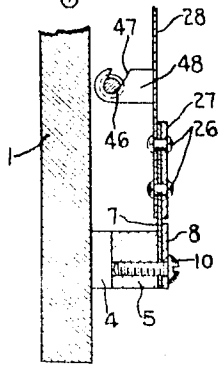


Fig 3

Fig 4



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UNITED STATES PATENT OFFICE

2,008,323

CONTROL DEVICE

George Bethune Duffield, Detroit, Mich., assignor to Detroit Lubricator Company, Detroit, Mich., a corporation of Michigan

Application June 22, 1933, Serial No. 676,988

14 Claims. (Cl. 236—44)

My invention relates to new and useful improvements in control devices, and more particularly to a device for actuating a control means to regulate the relative humidity of a room or other enclosed space in response to variation in the moisture content of the atmosphere therein. If the relative humidity of the space or room is maintained during the heating season at the desired degree of, say, 45 degrees, then when the outdoor temperature drops to and below, say 20 degrees, moisture in the room air will freeze on the window panes, which is objectionable as it obscures vision through the windows. The moisture will continue to collect and freeze on the windows and after a time, the inner film of frost will be melted by contact with the warm room air, the resulting water running down the windows onto the sills, usually forming dirty puddles. It is therefore one object of my invention to provide automatic means to regulate the control device so as to provide a lower degree of relative humidity or moisture content of the air in the room when the outdoor temperature drops below a given degree, thereby overcoming the foregoing objections.

Another object is to provide a humidity responsive instrument with temperature controlling means to regulate the operation of the instrument in accordance with variations in temperature.

The invention consists in the improved construction and combination of parts, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawing, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawing—

Figure 1 is a view in longitudinal vertical section of a control device embodying my invention, and taken on the line 1—1 of Fig. 2;

Fig. 2 is a view in elevation looking from the right of Figure 1;

Fig. 3 is a detail view in section on the line 3—3 of Fig. 2, and

Fig. 4 is a detail view in section on the line 4—4 of Fig. 2.

Referring to the drawing by characters of reference, 1 designates generally a substantially vertical base member preferably of insulating material, such as bakelite, and which is of elongated, substantially rectangular outline, having apertures 2 adjacent its opposite ends by which the base member may be secured to a wall or other supporting surface. Adjacent the lower end of the base member there is a support 3 extending transversely of the base member and projecting substantially horizontally from the front face thereof. The support 3 preferably comprises posts 4 which are connected by an intermediate bridge portion or member 5. Secured to the front face of the support 3 and extending upwardly therefrom substantially parallel to the base member, there are substantially parallel, spaced hinge members 6 of resilient sheet metal. Also secured to the front face of the member 3 and extending upwardly therefrom between the hinge members 6, there are substantially parallel, spaced hinge members 7, which are also of resilient sheet metal. The hinge members 6, 7 are fixed in position by clamping plates 8 and screws 9, 10 passed through the plates 8 and the hinge members and threaded into the support 3. The screws 9 preferably extend through the posts 4 and are threaded into the base member 1 to secure the support 3 thereto. Secured to the rear faces of the hinge members 6 and extending toward the base member there are substantially rectangular block or spacer members 11 which are rigidly fixed to their respective hinge members 6 by clamping plates 12 and screws 13. The clamping plates 8 and 12 are slightly spaced from each other at their adjacent edges, as at 14, to provide a fulcrum or pivot point for each hinge member 6. Secured by screws 15 to the rear faces of the spacer members 11, which are preferably of insulating material, are substantially parallel, spaced arms 16 of a plate or supporting member 17, the arms being formed by a substantially rectangular aperture 18 at the bottom or lower end portion of member 17. The supporting member 17 extends substantially parallel to and longitudinally of the base member 1, being fulcrumed for movement theretoward and therefrom by the hinge members 6. The member 17 is tapered at its upper end to provide an end portion 19 of reduced width. The portion 19 extends between the forwardly projecting arms or poles 20 of a U-shaped permanent magnet 20^a and lies against the magnet base to which it is secured by a rivet 21 such that the magnet is movably supported by the member 17. Secured to the front or outer face of the member 17 by the rivet 21 there is a supporting plate 22 which extends downward from the magnet. Adjustably screw-threaded through aligned apertures in the member 17 and plate 22 and projecting forwardly from the member 17 there is a control element or contact member 23 of an electric switch. The member

23 is provided at its inner or rear end with a slotted head 24 for screw-driver adjustment and is accessible for adjustment through an aperture 25 in the base member 1.

The hinge members 7 are secured by rivets 26 and a clamping plate 27 to the lower side edge portions of an operating member or lever 28, preferably of sheet metal, which extends upwardly substantially parallel to the base member 1 in spaced overlying relation to the supporting member 17. The upper end of the member 28 is provided with a reduced portion or neck 28a above which the member 28 terminates in an armature 29 cooperable with the magnet poles 20 and positioned in opposed relation thereto. The neck 28a permits the armature 29 to flex relative to the member 28 under the force of the magnet 20a. Rigidly fixed to the member 28 for engagement with the contact member 23 is the other contact member or control element 30 of the electric switch which is positioned between the armature portion 29 and the fulcrum of the member 28 and substantially at the neck 28a. Extending longitudinally of the member 28 there is an elongated central slot 31 open at its lower end and terminating at its upper end in an end wall 32. Positioned in the slot 31 there is a humidity responsive element 33, preferably a substantially cylindrical hollow member of wood having the grain extending transverse to its length. The element 33 is provided at its upper and lower ends with metal caps or end members 34, 35, the cap 34 abutting the end wall 32. The element 33 extends downward toward the support 3 with its longitudinal axis inclined toward the base member 1, and at its lower end engages an abutment member 36 which seats against the end cap 35. The abutment member 36 is reciprocable in the bore 37 of an adjustable sleeve member 38 and is resiliently supported therein by a coil spring 39 normally urging the abutment member into engagement with the element 33. The sleeve member 38 is adjustably screw-threaded in an aperture 40 through the bridge portion 5 of the support 3. The longitudinal axis of the aperture 40 is substantially parallel to the base member 1 and is so positioned that the abutment member 36 lies between the plane of the base member and the plane of the hinge members 7, the distance which the abutment member 36 is offset from the plane of the hinge members 7 determining the lever arm for the force of element 33 acting on the lever 28. Secured on the sleeve 38 below the support 3 there is an operating element 41 by which the sleeve member may be rotated to adjust the abutment member 36 and which is frictionally held in adjusted position by a leaf spring 42 which engages the underface thereof. The spring 42 is fixed to the base member 1 by a screw 43 having a head 44. Anchored to the head 44 there is one end of a helical spring 45 which extends longitudinally of the base member and through the aperture 18, being secured at its other end to a cross member 46. The member 46 seats at its opposite ends in upwardly open slots 47 formed in oppositely positioned, substantially parallel arms or flanges 48 projecting from the side edges of the member 28 toward the base member 1 and extending through the aperture 18. The spring 45 is normally under tension and opposes movement of the operating member 28 by the responsive means 33.

The supporting member 17 is automatically adjusted by temperature responsive means 49 relative to the base member to determine the extent of expansion and contraction of the element 33 necessary to move the elements 23 and 30 out of or into engagement The means 49 preferably comprises a substantially cup-shaped casing or container 50 having a lateral surrounding flange 51 at its rim to receive screws 52 by which the casing is secured to the rear face of the base member 1 in a position substantially midway of the length of the supporting member 17. Within the casing 50 there is a substantially cylindrical, metal bellows 53 which is secured and sealed at one end to an annular plate or ring member 54 sealed to the inside face of the casing adjacent its rim. The other end of the bellows 53 is secured and sealed to a head or end wall 55 so as to form an expansion chamber 56 within the casing 50. Through the end wall of the casing 50 there is an aperture 57 in which a plug member 58 is secured and sealed. Through the plug member there is a bore 59 which opens at its inner end into the chamber 56 and in the outer end of which a tube or conduit member 60 is secured and sealed. The other end of the tube 60 extends into a substantially cylindrical bulb element 61 which is hermetically sealed with the tube 60. The chamber 56 and element 61 are charged with a suitable expansible liquid through a filling tube 62 fixed in a ported plug 63 secured and sealed in an aperture in the end wall 55. The tube 62 and plug 63 are capped by a plunger member 64 which extends through an aperture 65 in the base member 1. At its inner end which is hollow to extend over the plug 63 and tube 62, the member 64 engages the end wall 55, and at its forward or outer end the member 64 engages the rear face of the supporting member 17 substantially at its midpoint. Expansion of the chamber 56 and movement of the wall 55 toward the base member 1 is opposed by a spring 65, preferably of the helical type, which surrounds the plunger 64, seating at one end against the end wall 55 and at its other end seating in a recess 66 formed in the rear face of the base member 1. The supporting member 17 is held in engagement with the plunger 64 by a spring-pressed plunger 67 which extends through an aperture in the member 17 and has a cross pin 68 overlying and engaging the front face of the member 17. The plunger 67 extends at its rear end into a sleeve member 69 secured in an aperture in the base member 1. At its inner or rear end the plunger 67 has a head or annular flange 70 which receives one end of a helical spring 71 surrounding the plunger 67 within the sleeve 69. The other end of the spring 71 engages a rearward facing annular shoulder in the sleeve 69 so that the spring being under compression normally acts through the plunger and cross pin 68 to urge the supporting member 17 into engagement with the plunger 64.

The operation of my control device is as follows: The base member 1 is secured to a support or wall in the room or space the humidity of which is to be controlled, with the contact members 23 and 30 connected by suitable lead wires, not shown, to a water control valve, for example, and the bulb element 61 is positioned outside of the room at a point subject to the temperature of the outdoor atmosphere. With the contact members 23 and 30 in engagement as shown, the moisture content or relative humidity of the air in the room will increase, causing the element 33 to expand longitudinally. When the expansive force of the element 33 acting between the abutment member 36 and the end wall 32 of

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the operating member 28 exceeds the force of the spring 45 and the attractive force of the magnet acting on the armature 29, the contact member 30 will be moved out of engagement with the contact member 23. The attractive force of the magnet acting on the armature 29 decreases quickly on initial movement of the armature so that contact is broken with a substantially snap action, thereby preventing arcing at the contacts. The differential operation of the device may be regulated by adjustment of the contact 23, the closer the armature 29 is permitted to approach the magnet poles 20 the greater will be the differential or the number of degrees variation in relative humidity between making and breaking of contact. The degree of relative humidity at which contact will be broken may be regulated by adjustment of the abutment member 36 which regulates the extent to which the member 33 will expand before breaking contact. If in normal operation with the contact members in engagement the outdoor temperature should decrease, this would result in a contraction of the liquid in the bulb 61 relieving the force acting on the bellows end wall 55. The spring 65 will therefore act to move the wall 55, permitting the spring 71 to act through the cross pin 68 to move the supporting member 17 about its fulcrum on the hinge member 6 toward the base member 1. This movement of the member 17 will break contact between the contact members 23 and 30 so as to stop further supply of moisture to the room air or increase in the relative humidity thereof. The control device which is thus automatically set to maintain a lower relative humidity by movement of contact member 23 relative to member 30 and toward the base member will now require further contraction of the element 33 before contact can again be made between the contact members 23 and 30. If the temperature surrounding the bulb 61 should increase, the force of the expanding liquid acting on the head 55 will overcome the spring 65 and move the plunger member 64 forward. As the plunger 64 moves forward, it will overcome the force of the light spring 71 and carry with it the supporting member 17 which will be rotated on its hinge members 6 away from the base member 1. If the contact members 23 and 30 are in engagement, the force acting on the wall 55 will act through the engaged contact members against the force of spring 45 to move the operating member 28 so as to require an increase in the relative humidity and expansion of the element 33 to break contact. If the contact members 23 and 30 are not in engagement upon an increase of outdoor temperature, the movement of the wall 55 may act to move the contact member 23 into engagement with the contact member 30 depending, of course, upon the extent of increase in outdoor temperature. It may be noted that the abutment supporting spring 39 serves to resiliently hold the element 33 in position and serves to take up overtravel or expansion of the element 33 after contact has been broken. The force exerted by the spring 39 acts, however, to support the abutment 36 against movement in the normal operation so that the force exerted by the element 33 will move the operating member 28 against the force of spring 45.

What I claim and desire to secure by Letters Patent of the United States is:

1. A device of the character described, comprising a base member having a support projecting therefrom, a movable supporting member mounted on said base member, a movable operating member pivotally mounted on said support, a control element carried by said supporting member, a control element carried by said operating member and engageable with said first-named control element, a humidity responsive member extending longitudinally of said operating member, said responsive member having one end engaging said support and having its other end engaging said operating member to move said first-named element relative to said second-named element, and means to adjust said supporting member whereby to regulate the engagement of said elements.

2. A device of the character described, comprising a base member having a support projecting therefrom, a movable supporting member mounted on said base member, a movable operating member, a resilient hinge member pivotally securing said operating member to said support, a control element carried by said supporting member, a control element carried by said operating member and engageable with said first-named control element, humidity responsive means for actuating said operating member to move said first-named element relative to said second-named element, and temperature responsive means carried by said base member and engaging said supporting member whereby to regulate the engagement of said elements.

3. A device of the character described, comprising a base member having a support projecting therefrom, a movable supporting member mounted on said base member, a movable operating member pivotally mounted on said support, a control element carried by said supporting member, a control element carried by said operating member and engageable with said first-named control element, humidity responsive means for actuating said operating member to move said first-named element relative to said second-named element, automatically acting means to adjust said supporting member, and means carried by said support and cooperable with said responsive means to regulate the operation of said operating member by said responsive means.

4. A device of the character described, comprising a base member, a support on said base member, a supporting member pivotally mounted on said support and having a contact adjacent its free end, an operating member pivotally mounted on said support and overlying said supporting member, a contact carried by said operating member and cooperable with said first-named contact, a humidity responsive member extending longitudinally of and having one end engaging said operating member and operable to move said second-named contact relative to said first-named contact, means opposing operation of said operating member by said responsive member, and temperature responsive means cooperable with said supporting member and operable to move said supporting member relative to said base member whereby to regulate engagement between said contacts.

5. A device of the character described, comprising a base member, a support on said base member, a supporting member pivotally mounted on said support and having a contact adjacent its free end, an operating member pivotally mounted on said support and overlying said supporting member, a contact carried by said operating member and cooperable with said first-named contact, a humidity responsive mem-

ber extending longitudinally of and having one end engaging said operating member and operable to move said second-named contact relative to said first-named contact, means opposing operation of said operating member by said responsive member, temperature responsive means carried by said base member, a plunger operatively connecting said last-named means and said supporting member, and a spring acting to maintain said supporting member in engagement with said plunger.

6. A device of the character described, comprising a base member, a movable supporting member pivotally mounted at one end on said base member, a magnet carried by said supporting member, a movable operating member pivotally mounted at one end on said base member adjacent the pivotal mounting of said supporting member and having an armature cooperable with said magnet, a control element carried by said supporting member, a control element carried by said operating member and engageable with said first-named control element, humidity responsive means extending longitudinally of and operatively engaging said operating member to move said first-named element relative to said second-named element, and means to adjust said supporting member whereby to regulate the engagement of said elements.

7. A device of the character described, comprising a base member, a support projecting from said base member, an abutment member carried by said support, an operating member pivotally mounted on said support adjacent said abutment member and carrying a contact, a humidity responsive element acting on said operating member and engaging said abutment member, a movable supporting member pivotally mounted on said base member and having a contact cooperable with said first-named contact, and temperature responsive means having abutting engagement with said supporting member whereby to regulate the engagement of said contacts.

8. A device of the character described, comprising a base member, a support mounted on said base member, an abutment member carried by said support, an operating member pivotally mounted on said support and carrying a contact, a humidity responsive element acting on said operating member and engaging said abutment member, a movable supporting member pivotally mounted on said support and having a contact cooperable with said first-named contact, and temperature responsive means to adjust said supporting member whereby to regulate the engagement of said contacts.

9. A device of the character described, comprising a base member, a support mounted on said base member, an abutment member carried by said support, an operating member pivotally mounted on said support and carrying a contact, a humidity responsive element acting on said operating member and engaging said abutment member, a movable supporting member having a contact cooperable with said first-named contact, said base member having an aperture therethrough, temperature responsive means carried by said base member, and a plunger extending through said aperture and operatively connecting said responsive means and said supporting member.

10. A device of the character described, comprising a base member, a support mounted on said base member, an abutment member carried by said support, an operating member pivotally mounted on said support and carrying a contact, a humidity responsive element acting on said operating member and engaging said abutment member, a movable supporting member having a contact cooperable with said first-named contact, said base member having an aperture therethrough, temperature responsive means carried by said base member, a plunger extending through said aperture and operatively connecting said responsive means and said supporting member, and means acting on said supporting member to maintain said supporting member in engagement with said plunger.

11. A device of the character described, comprising a base member, a support on said base member, an operating member pivotally mounted on said support, a spacer member pivotally mounted on said support, a supporting member fixed to said spacer member and extending in laterally spaced relation to said operating member, cooperable contact members on said operating member and said supporting member, humidity responsive means for actuating said operating member, and automatically acting means for adjusting said supporting member.

12. A device of the character described, comprising a base member, a supporting member pivotally mounted at one end on said base member, temperature responsive means engaging said supporting member intermediate its ends, resilient means holding said supporting member in engagement with said responsive means, an operating member pivotally mounted at one end on said base member adjacent the pivotal mounting of said supporting member, cooperable contact members carried by said operating member and said supporting member, and humidity responsive means for actuating said operating member.

13. A device of the character described, comprising a base member, a supporting member pivotally mounted at one end on said base member, temperature responsive means engaging said supporting member intermediate its ends, resilient means holding said supporting member in engagement with said responsive means, an operating member pivotally mounted at one end on said base member adjacent the pivotal mounting of said supporting member, cooperable contact members carried by said operating member and said supporting member, a magnet carried by the free end of said supporting member, said operating member having an armature cooperable with said magnet, and humidity responsive means for actuating said operating member.

14. A device of the character described, comprising a base member, a supporting plate pivotally mounted on and movable toward and from said base member, an operating lever overlying said supporting plate and pivotally mounted on said base member for movement toward and from said supporting plate, cooperable contact members carried by said plate and said lever, an abutment member carried by said base member, a humidity responsive element having one end engaging said abutment member and having its other end acting on said lever, and automatically operable means engageable with said supporting plate for adjusting said plate relative to said base member.

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